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## EDITORIAL

Nearly a year has elapsed since a bill was passed by the Legislature, creating an Agricultural Experiment Station, to be operated in connection with this College. Although there has not been sufficient time as yet to warrant the expectation of any big achievement, as a result of this measure, yet present indications are very hopeful and encouraging.

A fairly respectable number of work and dairy animals, including carabaos of special types, have been acquired for the new enterprise, additional farm machinery and laboratory apparatus have been purchased, and proceedings are being conducted for the expropriation of about two hundred hectares of good agricultural land adjoining the College grounds. Permanent poultry houses have been built, and materials have been secured for a barn, hog shelters, silos, and machinery bodega. A road which will bear heavy hauling has been graded from the campus into the farm—a greatly needed improvement. We understand that work will begin soon after January first on the construction of two new laboratory buildings to house the Departments of Entomology and Plant Pathology, and the Department of Chemistry, and these laboratories will provide special facilities for certain important features of the Experiment Station work.

The land and animals, especially, have for a long time been greatly needed for the College, both for use in connection with its large number of experimental cultures, and at the same time, and in the same connection, for instructional purposes. Now that we have

or are about to have, represented most of these essential features, and are to be given adequate equipment and other facilities, the efficiency of the College in the training of our youth for the profession of agriculture will be increased very materially.

In the days when its resources were very limited, previous to the creation of the Experiment Station, the College managed, under apparently insurmountable difficulties, to carry on some valuable experimental work. The results of these original investigations have been mostly published in the *Agriculturist*, and we are proud to say that they are a record of achievement by Filipino students that has never been surpassed by any other institution in the Philippine Islands representing any lines of technical or economic research.

The establishment of the Experiment Station at Los Baños not only benefits the College—to which it is a necessity—but it represents a real economy to the Government. Such an institution would eventually have had to be established in the Islands to meet the growing needs of the country; and if established elsewhere, there would have had to be secured separate personnel, laboratories, and equipment, to say nothing of the permanent crippling of the College that would have resulted. Created, as it is now, as a working part of the College of Agriculture, the professorial and student body forces are naturally constantly engaged in Experiment Station projects, and laboratories, farm animals, and land, also serve their double purpose as accessories both to instruction and to experimentation—as they must properly do in a college of university grade. Therefore, besides being advantageous as an economy to the government, there is also the added benefit that teaching work in the College becomes vastly more effective. Students are, as a result, saved from the anomalous condition—for a college of agriculture—of having to accept, from time to time, didactic expositions of agricultural fact, which may apply to local conditions or not, in the absence of any opportunity to see them tested in actual practice in which students themselves take an active part.

The positive results of experimental work in agriculture will be of practical value to the country, to just the extent that they reach the farmers of the Archipelago, for application on their farms. We believe that even under present conditions, only through the College of Agriculture and its graduates, can such widespead and effective dissemination of advanced agricultural knowledge be effected, since our numerous students, on returning to their own regions, or on being assigned for service in the different provinces after graduation, take with them the knowledge they gather from the work of the College of Agriculture and its associated Experiment Station. So that the College, in the widest sense, already possesses the beginnings of a very effective extension service, which will always be partly identical with, and part and parcel of, that of the Bureau of Agriculture.

We hope that our people, and our government officials and legislators, will continue to exhibit, as they have already done on numerous occasions, a keen interest in the work and welfare of the new Experiment Station, and that they will generously extend to it both material and moral support, as necessity arises during the course of its development.

# Spacing Experiments with Sugar Cane*

By José Mirasol y Jison

## INTRODUCTION

In 1915, the writer studied the chemical changes occurring during the ripening of sugar cane with a view to determining the time of maturity of three varieties of sugar cane grown at the College.[1] The present paper is a preliminary study of the effect of spacing on the yield of canes and the per cent of sucrose in sugar cane.

## PREVIOUS WORK ON CANE SPACING

How far apart the rows should be in cane planting, and what distance apart the plants should be in the rows are still open questions in the agronomy of sugar cane in the Philippines. The farmers have no rule to follow. In general, the practice is to plant the cane in rows from 50 to 100 centimeters apart, and 20 to 40 centimeters between plants in the row. The idea in close planting is that the greater the number of plants in the field, the larger will be the yield. While close planting more or less prevents a dense growth of weeds, it allows but little cultivation and produces only slender and weak canes. So close are the plants that when the cane has reached the height of about a meter, they fully occupy the ground, and it is then impossible to cultivate them without considerable injury to the roots and to the parts above the ground. Resulting from this practice is the fact that the yield of sugar in the Philippines varies from 12 to 80 piculs (759 to 5060 kilos) per hectare.[2] Such factors as soil fertility, action of fertilizers, climate, variety of cane, and cultivation influence the yield of cane per unit of area and the per cent of sucrose in the cane together with its purity; the spacing of cane may affect them also.

The literature consulted at the College of Agriculture scarcely contains any report of previous investigation on the subject of cane spacing. In 1891, the most economical spacing of cane was the subject of an extended study by Dr. Wm. C. Stubbs at Audubon Park, Louisiana.[3] In 1911, the same subject was slightly touched by Tem pongko[4] at the College.

Dr. Stubbs carried on a series o experiments with three-, four-, five-, six-, seven-, and eight-foot rows, both with plant cane and rattoon. His results showed that the three-foot rows had the highest percentage of purity, and the highest percentage of sucrose. In point of cane tonnage, he observed that the three-foot rows led the other spacings. His comparison of the results is as follows:[3]

| For plant cane, | *Tons* |
|---|---|
| Net increase of 3-foot rows over the 6-foot | 2.13 |
| Net increase of 3-foot rows over the 5-foot | 2.92 |
| Net increase of 3-foot rows over the 4-foot | 2.11 |
| Net increase of 4-foot rows over the 6-foot | 0.03 |
| Net increase of 4-foot rows over the 5-foot | 0.81 |
| Net decrease of 5-foot rows under the 6-foot | 0.79 |

* Part II of thesis presented for the degree of Master of Science, University of the Philippines, 1917. College of Agriculture No. 98. The first part was published in the Philippine Journal of Science ,A13: 135-146, 1918.

1 The Philippine Agriculturist and Forester 4: 101-108. 1918.

2 Statistical report of the Bureau of Agriculture for 1916.

3 Bulletin of the Sugar Experiment Station at Audubon Park, New Orleans, La. Second series, No. 14. ( ) 8.

4 The Philippine Journal of Science, A8: 159-164. 1913

| For rattoon, | *Tons* |
|---|---|
| Net increase of 3-foot rows over the 8-foot | 6.30 |
| Net increase of 3-foot rows over the 7-foot | 5.80 |
| Net increase of 3-foot rows over the 6-foot | 5.40 |
| Net increase of 3-foot rows over the 5-foot | 3.85 |
| Net increase of 3-foot rows over the 4-foot | 8.24 |
| Net increase of 5-foot rows over the 8-foot | 2.15 |
| Net increase of 4-foot rows over the 7-foot | 1.95 |
| Net increase of 4-foot rows over the 6-foot | 1.95 |
| Net increase of 6-foot rows over the 8-foot | 0.90 |
| Net increase of 6-foot rows over the 7-foot | 0.39 |
| Net increase of 7-foot rows over the 8-foot | 0.01 |

Dr. Stubbs' conclusions from the above results are that the cane gives sucrose, purity and pounds of sugar per ton inversely as the width of the rows; that there is nothing to be gained on the tonnage of sugar content by very wide rows. But he says that "while the increase in the narrow rows is quite apparent, the increments have hardly paid for the increased seed used in planting" and recommended that the five-foot rows be adopted.

Tempongko's results (*op. cit.*) seem to indicate that the yield of canes per hectare is larger in closer rows than in wider ones.

## THE PRESENT EXPERIMENTS

A level field with a clay-loam soil from which a crop of corn had been harvested was selected for the site of these experiments. This was not the same field that was used by either Tempongko or Asunción, where they obtained very low yields of cane per hectare.

Fifteen plots, each measuring 450 square meters, were originally laid out. But, when the plants were about three months old, it was found that in Plot 2 about 76% of the seeds had failed to grow, and, as it was rather too late to replant that plot, it was entirely abandoned.

The Sinanduyong variety was used in these experiments. Planting began March 10, 1916, and was finished March 16, 1916. The spacings were the following:

Plot 1. Rows—50 centimeters, seeds laid end to end.
Number of seeds needed—3,600.

Plot 3. Rows—75 centimeters, seeds laid 25 centimeters end to end.
Number of seeds needed—1,200.

Plot 4. Rows—1 meter, seeds laid end to end.
Number of seeds needed—1,800.

Plot 5. Rows—1 meter, seeds laid 50 centimeters end to end.
Number of seeds needed—600.

Plot 6. Rows—1 meter, seeds laid 75 centimeters end to end.
Number of seeds needed—450.

Plot 7. Rows—1½ meters, seeds laid end to end.
Number of seeds needed—1,200.

Plot 8. Rows—1½ meters, seeds laid 50 centimeters end to end.
Number of seeds needed—400.

Plot 9. Rows—1½ meters, seeds laid 75 centimeters end to end.
Number of seeds needed—300.

Plot 10. Rows—1¾ meters, seeds laid end to end.
Number of seeds—960.

Plot 11. Rows—1¾ meters, seeds laid 50 centimeters end to end.
Number of seeds needed—320.

Plot 12. Rows—1¾ meters, seeds laid 75 centimeters end to end.
Number of seeds needed—240.

Plot 13. Method of planting around the locality.
Rows—78 centimeters, seeds planted slantingly, 25 centimeters apart.
Number of seeds needed—1,140.

Plot 14. Rows—75 centimeters, seeds laid 50 centimeters end to end.
Number of seeds needed—800.

Plot 15. Rows—75 centimeters, seeds laid 75 centimeters end to end.
Number of seeds needed—600.

The rows were in North to South direction. The furrows in Plot 1 were made with a native plow, because they were so close that the double mouldboard plow which was used on the others would have turned the soil into the furrows on both sides, thus making them shallow. The seeds were covered by either hand or foot. All plots, except No. 1, received the same amount of cultivation and care. After three months, Plot 1 would not allow any further cultivation, and weeding was done by hoeing.

Two months after planting, the stools in each plot were counted. The results are given in Table I.

TABLE I

| *Plot No.* | *1* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* | *13* | *14* | *15* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of seeds planted..... | 3600 | 1200 | 1800 | 600 | 450 | 1200 | 400 | 300 | 960 | 320 | 240 | 1140 | 800 | 600 |
| No. of stools counted.... | 2473 | 800 | 1156 | 561 | 431 | 913 | 387 | 297 | 618 | 286 | 240 | 806 | 797 | 596 |
| Percentage of success..... | 68 | 65 | 64 | 93 | 95 | 75 | 97 | 92 | 64 | 89 | 100 | 70 | 99 | 99 |

As may be noted from the above table, the percentage of germination in every case where the seeds were laid end to end and in those where they were set 25 centimeters apart in the rows was much lower than in the plots where the seeds were set farther apart.

It had been found in the previous work by the writer that the variety of cane used in the present experiments would mature in from ten to eleven months. The canes were analyzed from January 23 to February 15, and they were harvested from March 2 to March 13. The same method and care in field sampling and in the analyses, as were followed in the writer's previous work, were observed. (*op. cit.*) During the harvest, the number of stools in each plot and the number of stalks to a stool were counted; the diameter of the middle portion and the height of 100 canes were measured; and the weight of canes from each plot was recorded. The field results and the analyses are given in Table II and III, respectively.

TABLE II

| | | *Plot Results* | | | | | | | | | | | *Hectare Basis* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Canes to the stool* | | | *Cane measurements* | | | *Actual wt. of canes at harvest in kgs.* | | *Yield of cane* | | |
| *Plot No.* | *Spacing cm.* | *No. of stools 3 mo. after planting* | *No. of stools at harvest* | *Mortality at harvest %* | *Ave. No.* | *Lowest No.* | *Highest No.* | *Ave. diam. cm.* | *Ave. Height m.* | *Ave. wt. of 100 canes* | | *Waste %* | *No. of tops required* | *In kilos* | *In tons* |
| 1... | 50×0 | 2473 | 938 | 62 | 5 | 1 | 11 | 1.95 | 2.71 | 107.31 | 3690 | 21 | 80000 | 82000.00 | 82.00 |
| 3... | 75×25 | 800 | 664 | 17 | 6 | 1 | 14 | 2.60 | 2.31 | 112.05 | 3040 | 25 | 26666 | 65444.44 | 65.44 |
| 4... | 100×0 | 1156 | 551 | 52 | 6 | 1 | 19 | 2.29 | 1.32 | 128.16 | 3382 | 19 | 40000 | 75155.55 | 75.15 |
| 5... | 100×50 | 561 | 500 | 11 | 7 | 1 | 17 | 2.71 | 2.27 | 112.21 | 2694 | 23 | 13333 | 59866.66 | 59.86 |
| 6... | 100×75 | 431 | 402 | 6 | 6 | 2 | 19 | 2.49 | 2.22 | 113.50 | 2635 | 16 | 10000 | 58555.55 | 58.55 |
| 7... | 150×0 | 913 | 423 | 53 | 6 | 1 | 19 | 2.64 | 2.22 | 112.18 | 2903 | 5 | 26666 | 64535.55 | 64.53 |
| 8... | 150×50 | 387 | 376 | 3 | 9 | 3 | 21 | 2.80 | 2.23 | 125.27 | 3642 | 4 | 8888 | 80933.33 | 80.93 |
| 9... | 150×75 | 297 | 296 | 0.4 | 8 | 1 | 18 | 2.85 | 2.23 | 126.03 | 3253 | 4 | 6666 | 72288.88 | 72.28 |
| 10... | 175×0 | 618 | 470 | 31 | 7 | 2 | 20 | 2.52 | 2.00 | 112.00 | 2403 | 2.5 | 22800 | 53400.00 | 53.40 |
| 11... | 175×50 | 286 | 286 | 00 | 7 | 2 | 17 | 2.64 | 1.87 | 113.41 | 2240 | 1 | 7581 | 49955.55 | 49.95 |
| 12... | 175×75 | 240 | 240 | 00 | 6 | 2 | 22 | 2.75 | 2.11 | 111.83 | 2445 | 2.5 | 5700 | 54331.01 | 54.33 |
| 13... | 78×25 | 806 | 696 | 13 | 5 | 2 | 16 | 2.45 | 1.96 | 110.31 | 3276 | 0.7 | 25200 | 72800.00 | 72.80 |
| 14... | 75×50 | 797 | 796 | 0.1 | 6 | 1 | 19 | 2.41 | 1.92 | 112.71 | 2680 | 1 | 17689 | 59555.55 | 59.55 |
| 15... | 75×75 | 596 | 593 | 0.5 | 6 | 1 | 16 | 2.58 | 2.06 | 118.17 | 3627 | 1 | 13300 | 80600.00 | 80.60 |

TABLE III

| Plot No. | Juice (Determined) | | | | | Bagasse (determined) | | | Cane (calculated) | | | Juice extraction by hand mill % | Tons 96° sugar from 100 tons cane | Quality of cane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Spacing cm. | Corrected Brix | Sucrose % | Purity % | Invert sugar % | Sucrose % | Invert sugar % | Fiber % | Sucrose % | Invert sugar % | Fiber % | | | |
| 1..... | 50×00 | 16.55 | 14.38 | 86.82 | 0.50 | 7.38 | 0.39 | 34 | 11.86 | 0.71 | 11.90 | 64.0 | 11.01 | 1:9.1 |
| 3..... | 75×25 | 16.55 | 14.71 | 88.88 | 0.21 | 7.85 | 0.09 | 32 | 12.25 | 0.24 | 11.50 | 64.2 | 11.53 | 1:8.7 |
| 4..... | 100×0 | 17.55 | 15.83 | 90.19 | 0.36 | 4.72 | 0.04 | 32 | 10.66 | 0.21 | 14.62 | 53.4 | 10.20 | 1:9.8 |
| 5..... | 100×50 | 17.10 | 15.17 | 88.71 | 0.58 | 9.20 | 0.06 | 33 | 13.01 | 0.38 | 11.88 | 63.9 | 12.22 | 1:8.2 |
| 6..... | 100×75 | 16.75 | 14.95 | 89.25 | 0.51 | 8.30 | 0.09 | 37 | 12.57 | 0.36 | 13.20 | 64.3 | 11.85 | 1:8.4 |
| 7..... | 150×0 | 17.25 | 15.71 | 91.07 | 0.37 | 10.68 | 0.06 | 34 | 14.03 | 0.26 | 11.56 | 66.0 | 13.32 | 1:7.5 |
| 8..... | 150×50 | 17.65 | 15.73 | 89.11 | 0.48 | 9.19 | 0.13 | 35 | 13.45 | 0.35 | 12.50 | 64.3 | 12.66 | 1:7.9 |
| 9..... | 150×75 | 15.67 | 13.18 | 84.11 | 0.47 | 8.76 | 0.15 | 32 | 11.67 | 0.35 | 10.89 | 66.0 | 10.68 | 1:9.5 |
| 10..... | 175×0 | 17.30 | 15.39 | 89.00 | 0.51 | 7.09 | 0.10 | 38 | 12.54 | 0.36 | 13.06 | 65.6 | 11.82 | 1:8.5 |
| 11..... | 175×50 | 17.17 | 15.25 | 88.81 | 0.48 | 6.38 | 0.08 | 36 | 12.23 | 0.34 | 12.25 | 66.0 | 11.50 | 1:8.5 |
| 12..... | 175×75 | 15.87 | 14.09 | 88.78 | 0.64 | 6.41 | 0.02 | 38 | 11.55 | 0.42 | 12.54 | 67.0 | 10.86 | 1:9.2 |
| 13..... | 78×25 | 17.76 | 16.11 | 90.70 | 0.34 | 9.53 | 0.08 | 34 | 13.91 | 0.25 | 11.45 | 66.3 | 13.22 | 1:7.6 |
| 14..... | 75×50 | 19.25 | 16.96 | 88.10 | 0.21 | 8.73 | 0.04 | 40 | 14.65 | 0.14 | 11.25 | 71.9 | 13.73 | 1:7.3 |
| 15..... | 75×75 | 16.08 | 13.71 | 85.26 | 0.66 | 9.61 | 0.09 | 36 | 12.48 | 0.45 | 12.68 | 64.8 | 11.31 | 1:8.8 |

Column 13 of Table II indicates the per cent of the total weight of cane per plot that was damaged mainly by rats. The rest of the columns are self-explanatory.

On close inspection of Table II, we find that the percentage of mortality of the cane between the time they were two months old and the time of harvest ranges from 0 to 62. In every case where the seeds were planted end to end in the rows, a high percentage of death occurred, while the reverse was true as the distance between the seeds in the row increased. This is undoubtedly due to the overcrowding of the plants, a condition which also is more favorable to the attacks of diseases. The optimum distance is shown to be 50 centimeters between seeds in the rows. The total number of canes per stool varies from 1 to 22 while the average is from 5 to 9. Here, we notice again that, in cases where the seeds were laid end to end, the tillering is small and, in cases where the seeds were 50 centimeters end to end, it is heavy. There is no gain in tillering if the distance between the seeds in the row is increased to 75 centimeters. This fact shows that the cane has a poor chance to sucker freely when planted closely. The variation in stooling also suggests the possibility of improving the stock by selecting the large stools for productive strains. The table also shows that the canes are small but long when planted closely, as in Plot 1, and large but shorter when given plenty of space, as in Plot 8. However, there is neither corresponding increase in size nor decrease in height as the spacing is widened either between rows or between plants in the row. Tempongko (*op. cit.*), measuring the growth of canes in various spacings, observed that the "growth in length was greatest in the most thickly planted plots, while the reverse is true in the gain measured by circumference." Table II further shows that the damage caused by rats in the cane fields may reach 25%. In tonnage, Plot 1 leads the others, and this fact corroborates Dr. Stubbs' finding that the closer the distance of planting the cane, the larger the tonnage. However, such a relation is not constant.

The effect of the different spacings on the yield of cane per hectare can best be understood with the aid of Chart I, figure 2, and II, figure 2. The different curves in Chart II, figure 2, indicate the effect of varying the distance between the seeds, the distance between

the rows remaining constant. Curve 1 shows the effect of changing the space between the seeds from 25 to 50, to 75 centimeters when the distance between the rows is 75 centimeters. There is at first a slight decrease and then a decided increase in the yield. When the rows are 1 meter apart (Curve 2), changing the distance from 0 to 50 centimeters, and from 50 to 75, a continuous decrease in the yield is caused, and the curve is pretty nearly a straight line. When the rows are 1½ meters apart the yield increases from 64.53 tons to 80.93 tons per hectare when the distance between seeds in the rows is changed from 0 to 50 centimeters; but, when this distance is further increased, there is a corresponding decrease in the yield. Curve 4, where the distance between the rows is 1⅓ meters, shows a slight decrease by changing the distance between the seeds in the rows from 0 to 50 centimeters, and a slight increase by increasing this distance from 50 to 75 centimeters. It is to be noticed that all points of Curve 4 are below the others indicating that the optimum effect of all the factors responsible for the changes in the yield brought about by changing the distances between the plants was passed when the distance from furrow to furrow was greater than 1½ meters.

Chart II, figure 2, shows the effect of changing the distance between the rows, the distance between the seeds in the rows remaining constant. Again we see in this chart that the yield in tons of cane per hectare is lower when the distance between the rows is 1¾ meters, than when it is less. The highest yield obtained in tons of cane per hectare is in the plot where the rows are 50 centimeters apart, and the distance of the seeds in the rows is zero. The next highest is that where the distance between the rows is 1½ meters and the seeds are set 50 centimeters apart.

Figures in Column 14, Table III, are obtained by means of the formula $96°S = P \times (1.4-\frac{40}{c})\ \frac{95}{96}$, where 96°S expresses the weight of commercial sugar polarizing 96° per 100 parts cane; P equals per cent sucrose in the cane (Column 10), and C equals purity of the juice.[1] The factor $\frac{95}{96}$ is obtaine from the mill extraction taken as 95% and from the per cent of sucrose in the commercial sugar.

Column 15 indicates quality of cane, which expresses the weight of cane required to produce 1 ton of sugar. This is termed the "quality ratio" by sugar men.

From Table III it is evident that in close planting the coefficient of purity is relatively high. Plot 13, in which the seeds were planted 78 centimeters between rows and 25 centimeters between the plants in the rows, shows the highest percentage of purity, and Plot 14, in which the seeds were planted 75 centimeters by 50 centimeters, shows the highest percentage of sucrose-content in the cane. Plot 1, however, where the seeds were planted closer and thicker than in Plot 13, has a purity even lower than the average of the other plots. Dr. Stubbs did not experiment on so close a distance as 50 centimeters but, in general, it may be said that the results of these experiments as to purity and sucrose-content of the cane confirm his findings.

The effect of spacing on the percentage of sucrose in the cane (see Table III) can best be understood with the aid of Chart I, figure 4, and II, figure 4. Chart I, figure 4, is similar to Chart I, figure 2, and Chart II, figure 4, is similar to Chart II, figure 2. It can be seen at a glance

[1] Formula derived from G. L. Spencer, A Handbook for Cane Sugar Manufacturers: 306 and 482. 1916.

that, if the distance from row to row is 1 meter, some factors tend to increase the per cent of sucrose in the cane as shown by Curves 1 and 2, as the distance between the seeds in the rows is increased from 0 to 50 centimeters, but that they decrease the sucrose per cent when this distance is made greater. If the distance between the rows is above 1 meter there is a slight decrease in the per cent of sucrose in the cane when the distance between the seeds in the rows is increased from 0 to 75 centimeters.

The effect of spacing on the purity of the juice is given in Chart I, figure 3, and II, 3. Curves 1 and 3 of Chart II, figure 3, show that for distances of 50 centimeters or less between seeds in the row, a change in the distance between the rows up to 1½ meters is accompanied by an increase in purity and thereafter by a decrease. The purity, of the juices from canes in plot 1½ meters by 50 centimeters is between the purities of the juices from plots 1½ meters by 0 centimeters and 1½ meters by 75 centimeters. The most striking curve in Chart I, figure 3, is Curve 3 which is almost a straight line, indicating that the purity of the juice when the distance between the rows is widest remains almost constant with changing distances between the seeds in the row. If the distance between the rows is less than 1¾ meters, there is a continuous decrease in the purity when the distance between the seeds in the row is increased up to 50 centimeters, but that there is a sudden decrease of purity in the case of 75-centimeter and 1½ meter rows, and a slight increase in the case of the 1-meter row, when the distance between the seeds in the row is increased.

Table IV summarizes the results of the experiments and gives the calculated yield per hectare both in tons of cane and in tons of 96° sugar. Although in tonnage Plot 1 led the others, it occupied only the fourth place when it came to comparing the amount of available 96° sugar that could be produced per hectare. This was due to the fact that canes from Plot 1 were inferior to those from Plots 8, 13, and 15 in the per cent of available sucrose. The spacing indicated in Plot 8 would produce the greatest weight of 96° sugar per hectare.

The relation between spacing and the tons of 96° sugar that could be produced from the canes per hectare is represented in Chart I, figure 1, and II, 1. The curves in Chart II, figure 1, all indicate that the tons of sugar per hectare for the same distance between the seeds in the row decrease as the distance between the rows is increased to 1 meter, but that, when the distance between the rows is increased to 1½ meters, there is a corresponding increase in the yield of sugar. When the distance between the rows is increased further to 1¾ meters there is a sudden drop. Chart I, figure 1, shows the relation between the tons of sugar per hectare and the changes in the space between the seeds in the row, with constant distance between the rows. Chart I, figure 1, and II, 1, both show that the best spacing for cane, at least in this locality, is 1½ meters between the rows, and 50 centimeters from seed to seed.

As may be noticed, no attempt is made to explain the different effects of spacing on the yield of cane in tons per hectare and on the per cent of sucrose in the cane, because there are a number of factors that may affect them at the same time. Undoubtedly, the principal factor concerned is the net amount of sunlight received by the plants which is a direct function of the spacing. But, the greater amount of cultivation and

the small amount of competition between the plants, which obtain in the widely spaced lots, are undoubtedly responsible also for the increased yield.

TABLE IV

| Plot Number | Spacing centimeters | Tons 96° sugar from 100 Tons Cane | Plot Yield | | Hectare Yield | | 96° sugar in tons | Gain of Plot 8 in tons of 96° sugar over the others |
|---|---|---|---|---|---|---|---|---|
| | | | Cane in kilos | 96° sugar in kilos | Cane in kilos | Cane in tons | | |
| 1 | 50×0 | 11.01 | 3,690 | 406.27 | 82,000.00 | 82.00 | 9.03 | 0.91 |
| 3 | 75×25 | 11.53 | 3,040 | 350.51 | 65,444.44 | 65.44 | 7.54 | 2.40 |
| 4 | 100×0 | 10.20 | 3,382 | 344.96 | 75,155.55 | 75.15 | 7.66 | 2.28 |
| 5 | 100×50 | 12.22 | 2,694 | 328.67 | 59,856.66 | 59.86 | 7.31 | 2.63 |
| 6 | 100×75 | 11.85 | 2,635 | 312.24 | 58,555.55 | 58.55 | 6.94 | 3.00 |
| 7 | 150×0 | 13.32 | 2,903 | 386.68 | 64,535.55 | 64.53 | 8.59 | 1.35 |
| 8 | 150×50 | 12.66 | 3,642 | 461.07 | 80,933.33 | 80.93 | 9.94 | — |
| 9 | 150×75 | 10.68 | 3,253 | 347.42 | 72,288.88 | 72.28 | 7.72 | 2.22 |
| 10 | 175×0 | 11.82 | 2,403 | 260.00 | 53,400.00 | 53.40 | 6.31 | 3.63 |
| 11 | 175×50 | 11.50 | 2,248 | 258.52 | 49,955.55 | 49.95 | 5.74 | 4.20 |
| 12 | 175×75 | 10.86 | 2,445 | 265.52 | 54,331.11 | 54.33 | 5.90 | 4.04 |
| 13 | 78×25 | 13.22 | 3,276 | 433.08 | 72,800.00 | 72.80 | 9.62 | 0.32 |
| 14 | 75×50 | 13.73 | 2,680 | 367.96 | 39,555.55 | 59.55 | 8.17 | 1.74 |
| 15 | 75×75 | 11.31 | 3,627 | 410.21 | 80,600.00 | 80.60 | 9.11 | 0.83 |

## CONCLUSIONS

*Indications are that:*

1. The percentage of success in germination is lowest in the thick planting and highest in the thin; the percentage of mortality of the canes between the age of two months and the time of harvest is higher in the former than in the latter.

2. When planted closely, the cane has poorer chance to sucker than when planted farther apart, consequently smaller stools are obtained in the first case, and larger ones in the second.

3. In general, when planted closely the cane tends to grow high, but small in diameter; but, when spaced widely, it tends to gain in diameter rather than in length.

4. The damage to cane fields caused by rats was found to reach 25% of the total weight of the cane.

5. The greatest yield in tons of cane per hectare was obtained from the plot where the canes were planted 50 x 0 centimeter apart. The greatest yield in tons of 96° sugar per hectare was obtained in the plot where they were planted 150 x 50 centimeters apart.

6. It is recommended that canes in this locality be planted at a distance of 150 x 50 centimeters. Aside from giving the highest yield of sugar per hectare this spacing would save seeds, labor and time, and would allow the greatest amount of cultivation without much injury to the roots of the plant as a whole. The gain per hectare of plot where the distance was used over that where the native method was employed (Plot 13) is 0.32 ton of 96° sugar which amount would sell, at the present[1] price, for forty-eight pesos.

[1] In March, 1917

For explanation of the following charts,
see pages 130 to 132.

CHART I.

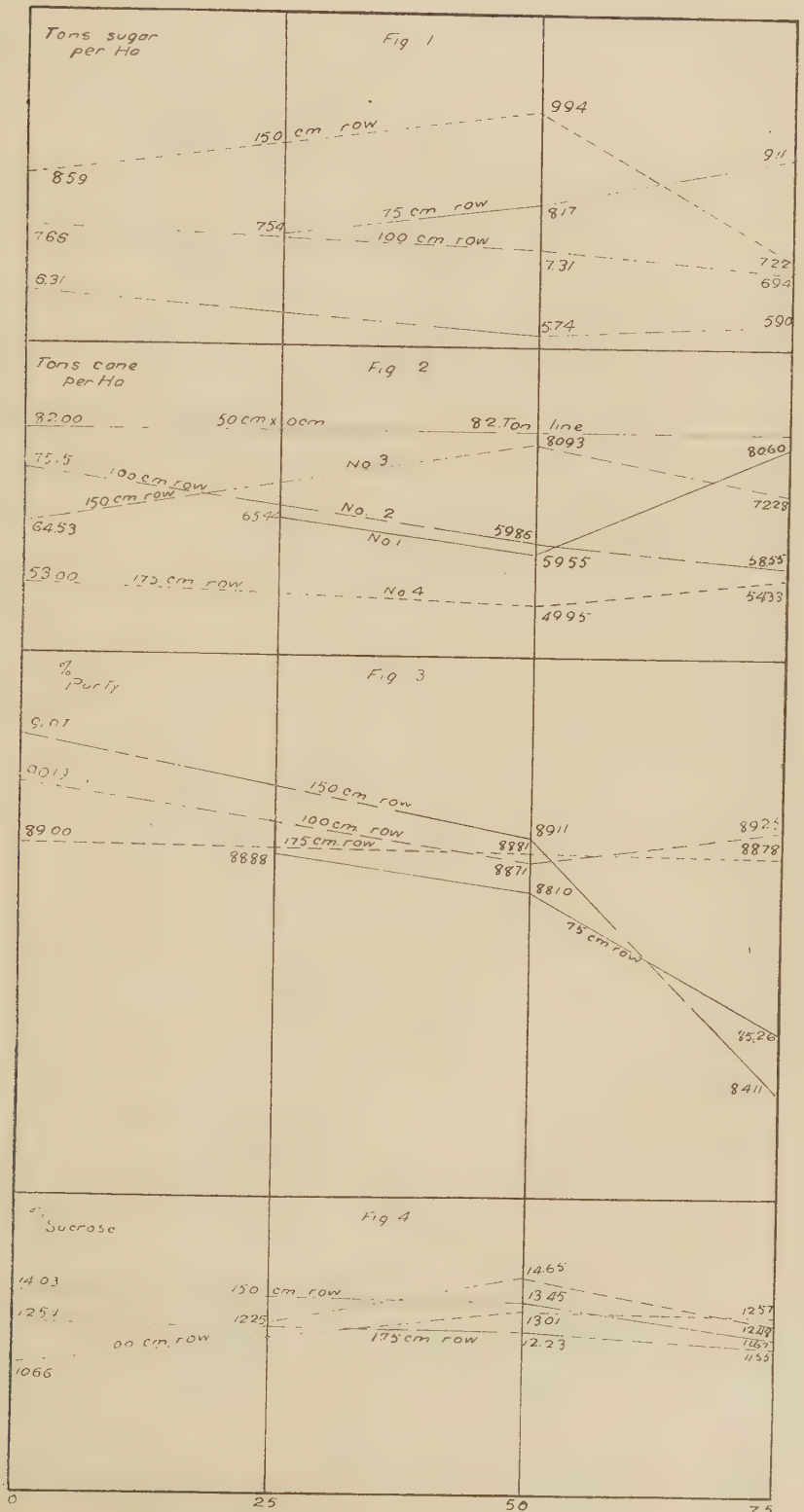
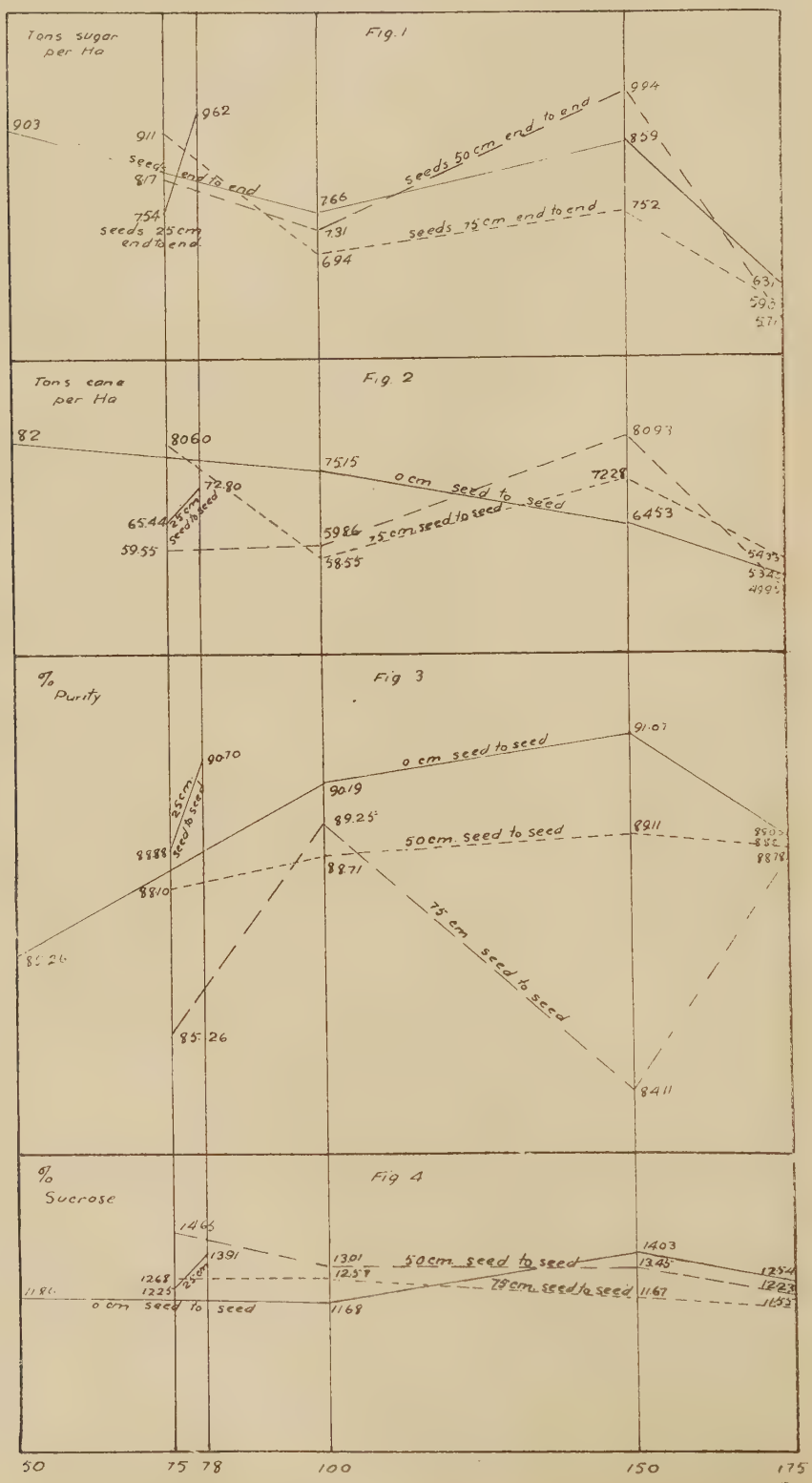

Tons sugar per Ha
Fig 1
994
150 cm row
911
859
75 cm row
817
766
754
100 cm row
731
722
694
631
574
590
Tons cane per Ha
Fig 2
82.00
50 cm x 50 cm
82 Ton line
8093
8060
75.15
100 cm row
No 3
150 cm row
No 2
7228
6544
5986
64.53
No 1
5955
5835
53.00
175 cm row
No 4
5433
4995
% Purity
Fig 3
9.01
150 cm row
8911
8925
89.00
100 cm row
175 cm row
8881
8878
8888
8871
8810
75 cm row
45.26
8411
% Sucrose
Fig 4
14.03
14.65
150 cm row
13.45
1257
1251
1225
1301
100 cm row
175 cm row
12.23
1066
1155
0
25
50
75

CHART II.


Tons sugar per Ha
Fig. 1
903
911
962
754
seeds 25 cm end to end
817
seeds end to end
766
731
694
seeds 50 cm end to end
994
859
752
seeds 75 cm end to end
Tons cane per Ha
Fig. 2
82
8060
7515
6544
5955
7280
5986
3855
0 cm seed to seed
8093
7228
6453
5475
5325
4995
25 cm seed to seed
75 cm seed to seed
% Purity
Fig 3
8126
9070
8888
8810
9019
8925
8526
8871
0 cm seed to seed
9107
8911
8878
50 cm seed to seed
8411
75 cm seed to seed
% Sucrose
Fig 4
1180
1268
1225
1466
1391
1301
1257
1168
0 cm seed to seed
25 cm
50 cm seed to seed
1403
1345
1254
1223
1167
1152
75 cm seed to seed
50
75
78
100
150
175

# A Comparative Study of Cantonese and Native Chickens*

By Gaspar Lindayag y Magtira

## INTRODUCTION

Poultry farming is not as yet recognized as a profitable business in the Philippines. The industry is regarded as of minor importance and receives little or no attention. A poultry farm here which has from 100 to 150 chickens is considered large.

That the Philippines are well adapted to poultry farming has been recognized by various poultry investigators. There are many sections which are rolling, well-drained and productive.

Crops for poultry feed can be grown at all seasons of the year. The occasional drought does not hinder the development and production of crops, if proper cultivation is maintained. Rice and corn are the most easily available grains for fowls in this country, although sorghum, millet and other grains are also grown. Leguminous seeds, such as cowpeas, mungo, etc., furnish rich nutriment when given to fowls. The root crops raised by the Filipino farmers can be used as partial substitutes for common poultry feeds. Green feeds, or succulents, would require very little of the farmer's attention, for grasses of all kinds are found fresh at all times of the year.

Meat for poultry is also available. Snails, small prawns, and insects are abundant in many places. Other animal foods that may be obtained easily are beef scraps and green bones from the local slaughter houses, widely scattered in the Islands.

The snails serve two purposes—for meat and for shell. Feeding with raw snails has been discontinued in this College due to the fact that the snail was found to be a host of intestinal parasites of poultry. Cooking the snails, however, makes them a safe food and the broth makes a rich drink for chicks.

The housing of poultry is one of the many essential factors of successful poultry culture. Poultry houses may be made of bamboo and nipa. Three houses of these materials for chickens were made in this College last year. These materials are abundant in this country and can be had rather cheap.

The objection to the use of these houses is that they form favorable dwelling places for lice and mites. After continuously housing chickens for about a year the bamboo and nipa houses at the College were examined for lice and mites on the 4th of February, 1918. Every crack in the ground and every hole and space in the houses that could possibly be a good hiding place for mites and lice were closely examined, but the houses were found to be free from these troublesome pests of poultry. Freedom from this vermin may be accounted for by the fact that the houses were cleaned every day, all droppings and rubbish removed, and the nesting material changed at frequent intervals. Also whenever these pests were observed, effective measures against them were taken, as dusting, greasing, etc., so they never got a good start.

The native chickens of the Philippines are the offspring of long continued crossing without selection. Consequently there are no established breeds of chickens in the Islands. They are neither egg nor meat producers.[1]

An attempt has been made to find out if the introduction of foreign breeds and the crossing of the pure breeds with the native stock will improve the Philippine chicken. Among the various breeds that the writer reared in 1916,

* Thesis presented for graduation from the College of Agriculture, No. 100

the Cantonese chicken was found to be best adapted to the conditions in this country. Velez found that the Mestizo, or grade Black Orpington and Single-Combed White Leghorn, which were the result of matings between pure-bred roosters with native hens, developed faster, matured earlier, and produced heavier than the native chicken.[2]

The present work was undertaken as an effort to further improve the native chicken. The purposes of the present investigations are: To compare the development of the Mestizo chickens produced by the mating of the Cantonese roosters and the native hens, and to observe the behavior of pure Cantonese chickens in the Philippines.

### SOURCE OF MATERIALS

Most of the eggs were purchased in the town of Los Baños and the neighboring localities, and hatched by artificial incubation. Some of the broody hens were obtained from outside sources because the number of setting hens in the College was not sufficient for experimental materials.

On February 7, 1917, nine Cantonese and sixteen native pullets from which egg-production during the first year was observed were housed in Poultry House No. 2.

### BREEDING

"Many different ideas prevail as to the number of hens that should be allowed to a cock. In this matter, much depends upon the breed of the fowls, much depends upon the way the fowls are kept, and much depends upon their ages and conditions. One should exercise some oversight as to the mating of his fowls and regulate the size of his breeding pen accordingly. With most breeds, we get a larger percentage of fertile eggs from a mating of a number, from ten to twelve hens to one cock."[3]

Following this suggestion, two Cantonese roosters were placed with nine Cantonese and sixteen native hens in Poultry House No. 2. In this case, the ration of mating was one cock to twelve hens.

### INCUBATION

Incubation is a natural process. But since early in the history of poultry culture, eggs of poultry have been incubated artificially, as well as naturally. Whether the method used is the natural or the artificial incubation, the aim of the operator is to get the highest percentage of hatchability.

During the progress of the present work, trials of both natural and artificial incubations were made at different times. As has been said above, some of the setting hens were obtained from the neighboring localities. These hens were dusted with lice powder before being allowed to set. The eggs were placed under them on the same day, and divided equally among them, giving each hen a chance to incubate each kind of egg under test.

On the sixteenth day of incubation, all the eggs under the hens were collected and separated according to breed. Then, one breed of eggs only was placed under each hen. This was done to avoid difficulties in identifying the breeds when the eggs hatched.

Several trials of artificial incubation were also made. The incubator (240 Eggs Hot-Water "Queen" Incubator) was run in accordance with the guide furnished by the manufacturers of the machine. The results of the first two trials were poor. The succeeding results of incubations showed no improvement over the first trials. These failures were undoubtedly due in part to the variable exposure of the incubator, as it was in a ground-floor room, and to the fact that some of the eggs were

more than two weeks of age; also the operator probably made errors in manipulation. The percentage of hatchability obtained by the writer ranged from 42 to 46% of fertile eggs. This was of the native eggs. The highest record of this incubator known by the writer was 76% of the native eggs, obtained by A. de la Paz, of the Animal Husbandry I Class of 1916. It must be noted, however, that two of the hatching experiments reported by the writer passed through the 1917 and 1918 Annual Exposition of the College. In showing the incubator to the public, the machine was opened for exhibition and explanation and the egg trays were disturbed a great deal, thus making the conditions unfavorable for hatching.

### FEEDS OF CHICKS AND TIME OF FEEDING

According to various poultry writers, no definite guide has yet been established for the feeding of chicks. The method of feeding depends entirely upon the purpose of the poultryman, the age of the birds, and the availability of feed in the places where the poultry is raised.

The chicks under experiment by the writer were given their first meal twenty-four hours after they were hatched. At first, they were fed four or five times a day. The first feed was hard-boiled egg chopped fine and mixed with ground corn or rice. This feeding was continued for a week. A regular ration followed, consisting of ground corn or rice and animal feed. This was given three times a day. Every morning the chicks were given light corn feed followed by cooked cracked snails. They were foraging most of the time and obtained some of their feed this way. At about twelve o'clock, they were given their noon meal. At four o'clock in the afternoon, they were penned and fed.

Since the opening of the College Mess Hall in 1917, the surplus boiled rice from the kitchen was given to the chicks, In addition to this feed, ripe papayas from the Department of Agronomy and rice bran mixed with ground corn, rice, eggs, or whatever else was available was given to the chicks. Charcoal. grit, and shell were placed before them all the time.

### HOUSING AND CARE OF CHICKS

Two days after hatching, when the chicks were strong enough, they were transferred to the rearing pens of the College, described in The Philippine Agriculturist and Forester, 5:105-106. 1916. Each pen was provided with one barrel turned on its side or a kerosene box containing some bedding. The motherless chicks, that is, those chicks hatched by the incubator were brooded in the incubator at night for a week or more. After their light morning meal, when the grass was not too wet, they were let loose in the range to forage and to exercise. The length of time allowed for foraging and exercising was gradually increased for each day.

At two weeks of age, the artificially reared chicks were not placed in the incubator any more, but brooded in a cold-frame brooder. This brooder may be made without difficulty. Although its efficiency was not as high as that of other artificial brooders or of the hen, it answered the purpose very well. The inside measurements of the frame were: length, 60 cm.; width, 40 cm.; height, 10 cm. An opening on one side for the passage of chicks measured 10 cm. long and 8 cm. wide. The top cover of the frame was made of flannel, but this could be made out of any other heat-absorbing cloth. The cloth was doubled and sewed at intervals to form pockets, which were as long as the frame and 5

cm. in width. These pockets were filled with saw dust. The cloth was nailed on the top of the frame. When not in use, this brooder was exposed to the heat of the sun to absorb as much heat as possible, which in turn warmed the chicks at night. The chicks were also provided with bedding.

Weaning of chicks was done when they were about two months old. At this time, they were transferred to the College poultry houses. Individuals showing any symptom of disease were at once isolated. They were confined in the coops prepared for the sick and treated. Care was taken to prevent all possible sources of infection.

SANITATION AND CONTROL OF DISEASES

The most important consideration in housing poultry is proper cleaning. A poultry house may be apparently clean, yet not absolutely free from parasites infesting fowls. Ordinary cleaning does not insure the safety of the fowls from diseases, hence, sanitation and disinfection must not be neglected. Experience shows that the occurrence of diseases among fowls is due usually to failure to clean and disinfect the poultry houses and their premises thoroughly.

The writer has observed that once a disease gains entrance among fowls, it progresses rapidly. When the symptoms appear, the organisms are already well established in the tissues of the infected birds. At this stage of the trouble, it may be too late to apply remedial measures. This is especially true in the case of internal troubles. The effect of disease is necessarily greater on the weaker birds than on the stronger. It has been shown that mature birds which were infected with any kind of disease during their period of growth are not as profitable and healthy as those kept free from infection. When disease appears, nothing better can be done than to isolate the diseased birds and either treat them or kill them.

Poultry keepers should not be so much concerned with the treatment of individual sick fowls as with the protection and saving from the infection of the uninfected part of the flock. Isolation and treatment of the sick are not enough, for infection spreads fast. Hygienic cleaning and disinfection are the only means of insuring protection of the healthy birds from infection. This must be done at regular intervals. In short, a poultryman's attention should be focussed on the fact that prevention is better than cure.( )

The chicks in this experiment being placed side by side in the rearing pens, the degree of exposure to the attack of diseases was the same throughout. Of the many diseases infecting the chicks both externally and internally, roup, chicken pox, and intestinal parasites caused the greatest number of deaths. Lowered vitality due to close confinement was probably the cause of the high percentage of mortality among the native chicks. Other diseases that caused more or less trouble were diarrhea, cold, thinning of the intestines, spotted liver, jaundice, and pericarditis.

Although the chicks were exposed to the same conditions, none of the Cantonese died from chicken pox and roup when the loss from those diseases among the native chicks was great. Thinning of the intestines also was found only among the native chicks.

Calomel (HgCl) applied externally gave good results with chicks infected with chicken pox, while no satisfactory remedy was found for roup. For intestinal parasites, purgatives were given. Good results were also obtained from the use of fresh and tender tobacco stems chopped fine and given to chicks. Lowry's lice powder, as described by Pearl,(4) gave decidedly good results in exterminating lice.

The occasional diseases among mature chickens did not cause much trouble. In the whole course of this experiment, no infectious disease ever attacked the adult chickens. When any suspicious symptom of a disease was noticed, the subject was at once isolated and treated. Scaly leg among mature fowls was treated with kerosene oil and vaseline.

GROWTH

In most poultry industries in Europe and the United States, pure breeds are used for the production of meat and eggs. Among pure bred chickens, the meat types grow the heaviest. Mongrel breeds are usually inferior in both development and egg production.

The present experiment furnishes evidence of the inferiority of the native chickens both in development and egg production. The trials of both Velez ( ) and Allarey ( ) point to the same conclusion.

Table I shows the average weight of chicks and the growth or increase in weight of the different kinds of chicks. The averaging was made on the number of chicks living at the time.

Twenty-four hours after hatching, the Cantonese chicks weighed 26.50 grams; the grade Cantonese, 21.27 grams; and the native, 22.27 grams, showing that at the start the Cantonese were heavier than the native and the native heavier than the mestizo. By the third week, the native had outgrown the Cantonese, weighing 85.29 grams., while 84.38 grams was the weight of the Cantonese and 81.23 grams; of the mestizo.* This fast growth of the native chicks continued until the fifth week, when they weighed 120.41 grams, the mestizo, 114.12 grams, and the Cantonese, 109.06 grams. Just a week later, the Cantonese weighed heavier than either of the other two breeds, being 0.26 grams heavier than the native and 9.75 grams heavier than the mestizo. In the eighth week, the mestizo chicks took the second place, weighing 193.64 grams and the native weighing 193.57 grams.

From the age of six weeks, the rate of growth of the Cantonese was the highest. From the age of eight weeks, the mestizo chickens remained in the second place. The native showed a marked decrease in the rate of growth from the eleventh till the eighteenth week.

From the same table, it may be seen that the native chickens were inferior to both the Cantonese and the mestizo in growth and development. The average weekly rate of increase in weight of the Cantonese was 23.86 grams; the mestizo, 19.64 grams; and the native, 16.46 grams.

## MORTALITY

In this experiment, the mortality among the chicks was closely observed. It is universally accepted that the first three or four weeks is the most critical period in the life of young chicks. Among the native chicks, natural weakness is the first cause of so many deaths. This was also true among the naturally incubated Single-Comb White Leghorn, and Barred Plymouth Rock chicks. Post-mortem examinations of about 100, or more, chicks showed that there was apparently no disease responsible for their early elimination.

It is not safe to conclude that all those that live through that critical period will reach maturity, for, in the first place, the surrounding conditions are so changeable; second, there may be a time in their life when they are either more susceptible or the diseases may become more virulent, consequently preventive measures will not avail, and third, bad management and wrong feeding are known to be important factors in the high percentage of mortality. In most cases, the attacks of diseases are only secondary causes of the death of a great number of chickens. (5)

In Table II, a direct comparison of mortality between the naturally and the artificially incubated and brooded chicks was made. In the natural incubation and brooding, after two months of age, 3 Cantonese chicks and 1 grade Cantonese died.

The greatest number of deaths was 130 of the native, 25 of the Single-Comb White Leghorn, and 10 of the Barred Plymouth Rock chicks. None of the Rhode Island Reds died. Two Cantonese and two Barred Plymouth Rock chicks were eaten by rats. After four months, the death rate of the native chicks was 93.5% of the ones remaining; of the Single-Comb White Leghorn, 97.6%; of the Rhode Island Red, 80%; and of the Barred Plymouth Rock, 88%. Again, some of the deaths were not caused by disease. Seven native and two Cantonese chicks died from a strong dosage of turpentine given them for treatment of intestinal parasites. At the age of six months, when they were nearing maturity, two each of the native, Rhode Island Red, and Barred Plymouth Rock chicks died, while none died from the Cantonese or the Single-Comb White Leghorn. In this comparison, because of the small number, the grade Cantonese should not be regarded.

* *Mestizo*—Spanish term for half-caste, which in this case refers to the grade Cantonese.

TABLE I
WEEKLY GROWTH OF CHICKS
WEIGHTS IN GRAMS

| Breed | Hatching 0 | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | 13th | 14th | 15th | 16th | 17th | 18th | 19th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cantonese: | | | | | | | | | | | | | | | | | | | | |
| No. of chicks | 42 | 41 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| Growth | 26.50 | 42.45 | 67.28 | 84.38 | 92.80 | 109.06 | 139.81 | 172.18 | 212.18 | 236.12 | 273.50 | 293.80 | 317.28 | 337.50 | 376.35 | 430.63 | 466.51 | 485.64 | 507.07 | 532.15 |
| Grade Cantonese: | | | | | | | | | | | | | | | | | | | | |
| No. of chicks | 18 | 16 | 16 | 16 | 15 | 14 | 14 | 14 | 14 | 13 | 12 | 12 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 7 |
| Growth | 21.27 | 30.04 | 50.16 | 81 23 | 91.42 | 114.12 | 130.06 | 158.73 | 139.64 | 223.15 | 283.11 | 251.08 | 263.48 | 291.70 | 310.13 | 318.22 | 336.61 | 362.29 | 390.25 | 402.52 |
| Native: | | | | | | | | | | | | | | | | | | | | |
| No. of chicks | 261 | 215 | 176 | 132 | 68 | 53 | 42 | 30 | 26 | 26 | 20 | 14 | 11 | 11 | 11 | 11 | 10 | 10 | 9 | 9 |
| Growth | 22.27 | 36.54 | 52.71 | 85 29 | 100.83 | 120.40 | 139.55 | 171.42 | 193.57 | 220.63 | 242.82 | 251.31 | 259.39 | 274.60 | 281.85 | 290.11 | 296.20 | 309.62 | 318.80 | 330.15 |
| GAIN IN WEIGHT | | | | | | | | | | | | | | | | | | | | |
| Cantonese | | 15.95 | 24.83 | 17.10 | 8.42 | 16.26 | 30.75 | 32.37 | 40.00 | 23.94 | 37.38 | 20.30 | 23.48 | 20.22 | 38.85 | 44.28 | 35.94 | 19.07 | 21.43 | 25.08 |
| Grade Cantonese | | 8.77 | 20.12 | 31.07 | 10.19 | 22.70 | 15.94 | 28.67 | 34.91 | 29.51 | 14.96 | 12.97 | 14.40 | 28.22 | 18.43 | 8.09 | 18.39 | 25.68 | 27.96 | 12.27 |
| Native | | 14.27 | 16.17 | 32.58 | 15.54 | 19.58 | 19.14 | 31.78 | 22.15 | 24.06 | 22.19 | 8.49 | 8.08 | 15.21 | 7.25 | 8.26 | 6.09 | 13.42 | 9.18 | 11.35 |

| Breed | 20th | 24th | 28th | 32nd | 36th | 40th |
|---|---|---|---|---|---|---|
| Cantonese: | | | | | | |
| No. of chicks | 37 | 37 | 37 | 37 | 37 | 37 |
| Growth | 558.15 | 651 | 722 | 855 | 10.78 | 1261 |
| Grade Cantonese: | | | | | | |
| No. of chicks | 7 | 7 | 7 | 7 | 7 | 7 |
| Growth | 420.21 | 598 | 699 | 892 | 954 | 1028 |
| Native: | | | | | | |
| No. of chicks | 8 | 7 | 7 | 7 | 7 | 7 |
| Growth | 358.20 | 487 | 671 | 782 | 880 | 985 |

| | |
|---|---|
| Cantonese | 26.00 |
| Grade Cantonese | 11.69 |
| Native | 28.05 |

AVERAGE WEEKLY GROWTH

| | |
|---|---|
| Cantonese | 23.86 grams |
| Grade Cantonese | 19 64 grams |
| Native | 16 64 grams |

Table II shows plainly that the Single-Comb White Leghorn, Rhode Island Red, and Barred Plymouth Rock chickens are not yet adapted to the conditions of this particular place, the percentage of mortality being 97.6, 100, and 100, respectively. The native chickens with 94.8% mortality showed as poor result as the first three breeds. On the contrary, good results were obtained from the Cantonese chicken, the percentage being 18.5 and if those that died from the turpentine treatment are not included, the percentage of mortality would be 11.1%. The same condition would give 90.3 for the native. Of the four breeds of chicken that the writer reared, the Cantonese was found to be, as has been said before, best adapted to the conditions in this place.

TABLE II

MORTALITY

| *Breeds* | *No.* | *After 2 mo.* | | *After 4 mo.* | | *After 6 mo.* | | *% Mortality* |
|---|---|---|---|---|---|---|---|---|
| | | *Dead* | *Living* | *Dead* | *Living* | *Dead* | *Living* | |
| | *Natural Incubation* | | | | | | | |
| Cantonese | 27 | 3 | 24 | 5 | 22 | 5 | 22 | 18.5 |
| Grade Cantonese | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 66.6 |
| Native | 156 | 130 | 26 | 146 | 10 | 148 | 8 | 94.8 |
| S. C. W. Leghorn | 42 | 25 | 17 | 41 | 1 | 41 | 1 | 97.6 |
| R. I. Red | 10 | 0 | 10 | 8 | 2 | 10 | 0 | 100.0 |
| B. P. Rock | 18 | 10 | 8 | 16 | 2 | 18 | 0 | 100.0 |
| | *Artificial Incubation* | | | | | | | |
| Cantonese | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 00.0 |
| Grade Cantonese | 15 | 3 | 12 | 9 | 6 | 10 | 5 | 66.6 |
| Native | 105 | 105 | 0 | 105 | 0 | 105 | 0 | 100.0 |

In the case of the artificially incubated and brooded chicks, no death occurred among the Cantonese and only three of the grade Cantonese died, while all the native chicks were dead after two months. The Cantonese chicks, at this age, were in perfect health. Six of the Cantonese mestizo died between the fourth and the sixth months. After six months, no deaths were recorded in any of the lots.

This seems to point out that the native chicken does not stand artificial conditions well.

MATURITY

Animals are said to be matured when they begin to reproduce. Reproduction follows growth and development, although, in most animals, it comes when they are yet growing and developing. In some instances, however, abnormalities may hasten or delay reproduction.

By maturity of chickens here is meant the time the first egg is laid by the pullet.(5) In well-established and well-defined breeds of chicken, maturity has been closely studied. Their ages, when mature, are shown as follows: (6)

Laying breed.....about 5 mo. (150 da.)*
General purpose breed...about 6 mo. (180 da.)
Meat Breed.....about 7-8 mo. (120-124 da.)

Feeding has a direct relation to maturity of chickens. That chickens may be forced to early maturity by some feed stimulants, not only for egg-production but also for meat production, has been found by experiment.

In the present test, the pullets nearing maturity were not forced to lay early. They were given plain diet which could tend to insure their normal maturity. They were allowed more or less free range.

* The figures in parentheses are my own.

TABLE III

MATURITY OF CANTONESE CHICKENS

| Breeds | No. of Hens | Age in days when first egg was laid | | |
|---|---|---|---|---|
| | | Min. | Max. | Av. |
| Velez' Chickens: | | | | |
| Mestizo B. Orpington | 17 | 256 | 342 | 300.0 |
| Mestizo S. C. W. Leghorn | 15 | 276 | 326 | 302.7 |
| The Writer's Cantonese | 16 | 156 | 314 | 248.2 |
| Grade Cantonese | 2 | 234 | 245 | 239.5 |
| Native | 2 | 261 | 265 | 263.0 |

The two Cantonese pullets that laid their first egg earliest were hatched one on March 20 and the other on April 16, 1917. They were about 5 months old—one 156 and the other 168 days—when their first eggs were recorded. The latest Cantonese pullet to lay her first egg was noted when she was about 10½ months, or 314 days, old.

The grade Cantonese and the native pullets were too few in number to give reliable figures on maturity. The former began laying later than the Cantonese but earlier than the native pullets. Lastly, the native pullets were found to be the latest to mature among the breeds under experiment.

The mestizo Black Orpington and S. C. W. Leghorn chickens matured later than the Cantonese chickens.

Considering the maturity of well-established laying, general-purpose, and meat breeds of poultry which are recognized in the United States and Europe, the Cantonese chickens, on an average, mature the latest.

## CHARACTERISTICS OF THE CANTONESE AND THE GRADE CANTONESE CHICKENS

The Cantonese chicken is, as yet, not a standard breed.* There is a great deal of variation in the plumage, as well as in shape. For further improvement of the breed and to meet a set standard, a series of matings followed by judicious selection should be made. The following ideal description of the Cantonese chicken was furnished by the Animal Husbandry Division of the Bureau of Agriculture.

## DESCRIPTION OF THE CANTONESE CHICKENS

Comb—upright, single, of medium size and free from side sprigs.

Wattles—of medium size and well rounded.

Ear lobes—red.

Beak—stout and black, streaked with yellow.

Head—broad, flat and short with no topnotch.

Eyes—bright, reddish brown.

Neck—short and thick, especially near the body into which the hackle feathers should be well set in. No muff.

Back—flat, square, very broad across the shoulders and saddle and of fair length.

Breast—broad, deep, coming well forward and rounded.

Sides—deep.

Wings—closely tucked to body.

Body—thick, deep and compactly built.

Tail—short, feathers and sickles stout.

Thighs—short, wide apart, with plenty of body between.

Shanks—of medium length and stout, straight, yellow or orange; not feathered. Shanky birds not desirable.

Toes—four, clean, straight and strong, same color as shanks.

Plumage—buff solid preferable. Buff with a few black feathers in wings not objectionable. The males generally have a darker shade of color than the

* The Cantonese is not recognized as a standard breed. Native chickens from the region around Canton, China, are imported and brought here under that name. As is usually the case with native stock, they are exceedingly variable. The results presented, therefore, should not be interpreted as necessarily applicable to all kinds of chickens under the name Cantonese. The stock used in these experiments is from the Alabang Stock Farm of the Bureau of Agriculture.

females, which, as a rule, have a more even color.

Size—fairly large.

Shape—symmetrical.

It was noticed in the Cantonese chickens reared at the College that both the tail and the sickle feathers grow rather late. Specimens more than a year old appeared sometimes to be tailless and, after they grew, they were rather short and small.

### DESCRIPTION OF MESTIZO, OR GRADE, CANTONESE CHICKENS

Although the Cantonese chickens have characters which are dominant over those of the native, the grade Cantonese have not acquired fully the usual characters common to the Cantonese. The grade males follow closely the Cantonese characters as to color of feathers, shank and beaks. A great variability was noticed on the five grade females, only two inherited the color characteristic of the female Cantonese.

## EGG PRODUCTION

The production of eggs requires a careful consideration. The health of the bird that lays it has a direct bearing on the make up of the egg. The materials for egg production are either taken from the surplus available nutriment in the body of the fowl or directly drained off from the body of the bird. If the fowl is well fed, the materials for egg production are supplied partly by the excess available food in the body, and in this case the direct relation of good feeding to egg-production enters.( )

The various factors of the environment, such as housing, feeding, management, and other variable conditions, affect the egg yield. If these conditions are not favorable, the egg yield will tend to be low. On the other hand, experiments reveal the fact that good feeding, wise management, and proper housing influence the egg production for the better.(7)

The native chicken of the Philippines is popularly known to be a poor layer. Although investigations are, as yet, not conclusive, the present laying capacity indicates that this is true. In the present work a preliminary study of egg production of the native hens was made.

## FEEDING LAYING HENS

For egg-production, sound and healthy birds are necessary. However, a flock of undesirable hens may be kept, but if the aim is egg-production, this stock is a certain source of loss. In all breeds of chickens, it has been found that hens lay the largest number of eggs during their pullet year.

The method of feeding, as well as the amount and nature of feeds given, are the controlling factors in maximum egg production. A variety of simple food which serves the many purposes of egg production and which stimulates the normal functioning of the body is all that is needed. However, it must not be forgotten that plenty of air and exercise are also essential.( )

In this test, the aim was to obtain a record of the number of eggs produced during the hen's pullet year without stimulation and to keep the health of the laying fowls sound. Corn or rice with cooked snails formed their main ration. A mash mixture composed of three parts cracked corn, 2½ cracked rice, 3 parts rice bran, and 1½ parts copra meal was given at all times to the hens in a self-feeder. In the runs, sorghum and corn were grown in alternating yards. Grit, shells and charcoal were placed at all times before the birds. A very dilute solution of potassium permanganate, just enough to give a slight color to the water, was used for their

drink. Fruits, when available, were furnished to the fowls.

Trap nests were provided. One trap nest to every four or six hens was found to be a fair allowance. Without the trap nest, the selection of the best laying hens, upon which the industry will partly or wholly depend and the discarding of the poor layers could hardly be done.

## MONTHLY EGG PRODUCTION

Records of egg production were begun on February 18, 1917, when one of the Cantonese pullets laid her first egg, although most of the pullets of this breed began laying about the later part of March. With the native pullets, records began on March 24 of the same year, but the majority laid their first egg within the month of April. Three native pullets laid their first egg the latest, one on June 15, one on July 9, and one on July 14. These observations on egg production are still in progress and will be continued until each hen has completed her first year of laying. Table IV shows the number of eggs that have been produced by February 28, 1918.

TABLE IV

MONTHLY EGG PRODUCTION OF INDIVIDUAL HENS

| *Breed* | | *Age in days when 1st egg was laid* | *Feb.* | *Mar.* | *Apr.* | *May* | *June* | *July* | *Aug.* | *Sept.* | *Oct.* | *Nov.* | *Dec.* | *Jan.* | *Feb* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cantonese* | | | | | | | | | | | | | | | |
| D— | 1 | 221 | 7 | 5 | 2 | – | 1 | 1 | 2 | – | – | – | – | 3 | 1 |
| D— | 2 | 240 | – | 14 | 8 | 2 | 5 | 4 | – | – | – | – | 1 | 1 | 6 |
| D— | 3 | 263 | – | – | 10 | 4 | 1 | 1 | 1 | 4 | – | – | – | 2 | – |
| D— | 4 | 254 | – | 8 | 2 | 5 | 4 | 3 | 2 | – | – | – | – | 1 | 4 |
| D— | 9 | 256 | – | 2 | 1 | 1 | – | – | – | – | – | – | – | – | – |
| D— | 13 | 263 | – | – | 7 | – | – | – | – | – | – | – | – | – | – |
| D— | 14 | 246 | – | 5 | 7 | 7 | 6 | – | 3 | 2 | 3 | – | – | – | 4 |
| D— | 15 | 256 | – | 7 | 9 | 5 | – | – | – | 2 | – | 4 | – | – | – |
| D— | 16 | 246 | – | 10 | 3 | 3 | Died June 15, 1917. | | | | | | | | |
| *Native* | | | | | | | | | | | | | | | |
| C— | 30 | 265 | – | – | 9 | – | – | 5 | 5 | 6 | 1 | – | 1 | 3 | 4 |
| C— | 31 | | – | – | 3 | – | – | – | – | – | – | – | – | – | – |
| C— | 33 | | – | 1 | 4 | 3 | 3 | 1 | 2 | – | – | – | 1 | 1 | 5 |
| C— | 34 | | – | – | – | – | – | 2 | 2 | – | – | – | – | 2 | 6 |
| C— | 35 | | – | – | 1 | 1 | – | – | – | – | – | – | – | 1 | 4 |
| C— | 36 | | – | 1 | 8 | 2 | 1 | 3 | – | 3 | – | – | 2 | – | – |
| C— | 37 | | – | – | 5 | 2 | 2 | – | – | – | – | – | – | – | 5 |
| C— | 38 | | – | – | 6 | 5 | 5 | 2 | 2 | 3 | – | – | – | 6 | 5 |
| C— | 39 | 261 | – | – | 5 | 3 | 5 | 2 | – | 1 | – | – | 2 | – | 3 |
| C— | 40 | | – | 1 | – | – | – | – | – | – | – | – | – | – | – |
| C— | 43 | | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| C— | 44 | | – | – | 1 | – | 3 | – | – | 1 | – | – | – | – | – |
| C— | 46 | 271 | – | – | 4 | 4 | 4 | – | 1 | 5 | 1 | – | – | – | 4 |
| C— | 47 | | – | – | – | 1 | – | – | – | – | – | – | – | – | 3 |
| C— | 48 | | – | – | – | – | 1 | – | – | – | – | – | – | – | 3 |

NOTE:—The unidentified eggs were not included in the above table. Figures at the upper right hand corner indicate the dates when the first egg was laid.

The unidentified eggs were laid on the floor, on the dropping boards, and in the yard. Two cases were known of hens laying in the trap nest and successfully escaping after the egg was laid. From February 18, 1917, to February 28, 1918, twenty-eight eggs were recorded unidentified, an average of 1.2 eggs per hen.

## WEIGHT OF EGGS

The identified eggs were collected and weighed as soon as possible after laying.

TABLE V

COMPARISON OF WEIGHTS OF EGGS

| *Breeds* | *No. of Dozen* | *Ave. wt. of eggs* | *Ave. wt. per doz.* |
|---|---|---|---|
| Velez' Mestizo | | gm. | gm. |
| Black Orpington.. | 19 | — | 532.51 |
| White Leghorn... | 12 | — | 513.79 |
| The Writer's | | | |
| Cantonese..... | 17 | 36.16 | 433.92 |
| Native..... | 17 | 38.25 | 459.00 |

Table V gives the number of identified eggs laid up to February 28, 1918, the average weight of eggs and the average weight per dozen. The native eggs were heavier than the Cantonese, being 38.25 grams as against 36.16 grams. The Cantonese and the grade Cantonese eggs, like the eggs of the native, were of various shapes and shell-color with or without tints of deep brown.

The average weight of the eggs of the mestizo Black Orpington and White Leghorn, as shown in Table V, were 98.59 and 79.87 grams heavier than the Cantonese and 73.51 and 54.79 grams heavier than the native eggs per dozen, respectively.

While the Cantonese grew faster than the natives from the sixth week on, they evidently did not keep up this advantage to maturity.

TABLE VI

WEIGHTS OF MATURED CHICKENS

| *Breeds* | *No.* | *Ave. Wt. kilogr.* | *Ave. Wt. pounds* |
|---|---|---|---|
| Allarey: | | | |
| Native roosters..... | 100 | | 3.928 |
| Native hens..... | 132 | | 2.536 |
| Writer: | | | |
| Cantonese roosters.. | 9 | 1.400 | 3.080 |
| Cantonese hens..... | 14 | 1.005 | 2.211 |
| G.Cantonese roosters | 2 | 1.235 | 2.717 |
| G.Cantonese hens... | 5 | 0.980 | 2.156 |
| Native roosters..... | 18 | 1.505 | 3.311 |
| Native hens..... | 35 | 1.031 | 2.266 |

Table VI shows that the Cantonese chickens did not grow to maturity as heavy as the natives. The weights for the grades, although presented, should not be considered, as they were young and have not completed their growth.

## CONCLUSIONS

1. The adaptability of the Philippines for poultry farming offers an opportunity for success in this industry.

2. Among the various breeds of chickens that the writer reared, the Cantonese was found to be best adapted to conditions in this country.

3. The Cantonese chickens, whether artificially or naturally incubated and brooded, withstand the change of conditions better than the other breeds reared by the writer. They were found more resistant to diseases.

4. The Cantonese chickens developed faster than either the grades or the natives.

5. Most of the Cantonese pullets matured earlier; that is, they laid their first eggs earlier than the native or the mestizo, or grade, Cantonese, the grade Black Orpington, or the grade White Leghorn chickens.

6. The Cantonese eggs weighed lighter than those of the native.

7. The native chickens do not stand close confinement well.

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# Élite Culture and Multiplication of Some Standard Ilocano and Tagalog Lowland Rices*

By Leon M. Romero

## INTRODUCTION

The present work is the continuation of Mariano E. Gutierrez' thesis.[1] The object of his work was "to make a beginning in the isolation of productive strains of some Ilocano and Tagalog lowland rices of general value." The present work takes up the work where he left off, that is, the culture of the élites and the multiplication of the seeds from the best test-rows. His cultural and laboratory methods of observation were closely followed, except where an improvement could be made, as in the case of the number of plants in the test-rows; where he had a variable number of plants used, the writer made it uniform—100 plants to the row, believing that better and more accurate results would thus be obtained. In harvesting the plants in the test-rows a modification was also made; instead of measuring the individual production of the plants by harvesting and weighing their seeds separately, as was done by Gutierrez, the present writer selected only the best plants for the next élite culture. After discarding the obviously poor ones, the height of the rest of the plants was measured, their culms counted, and then they were threshed and the whole amount of grains weighed. These seeds constituted the material for the next multiplication culture.

## MATERIALS USED

Not all the élites and test-rows selected for multiplication were planted. A further elimination of low-yielding individuals and test-rows was made before planting began.

## GERMINATING AND PLANTING

The seeds were carefully separated, put in small cloth bags and properly labeled. These small bags, in turn, were encased in several larger ones and placed in running water for twenty-four hours. The sacks were removed from the water and the seeds allowed to sprout. On the fourth day, August 4, 1917, after removal from the water, the seeds were planted, carefully labeled, on a well prepared seed-bed, half wet, and enclosed by a bamboo frame.

Three days later the seed-bed was watered, but four days afterward, because of the dry weather and the insufficient supply of water from the pipe, the seed bed dried up and the seedlings suffered slightly from lack of water. As in the case of the parents noted by Gutierrez, a considerable variation in germination among the seeds of different progeny was observed by the writer.

When the seedlings reached an age of 27 days, measurements were taken and averaged for each variety. The averages, then, were classified according to their frequencies in the scale of height.

From the measurements there was noted a great difference in vigor between the parents and the progeny. In Binicol, for example, the parents reached a height of 43.5 centimeters in 27 days, when the tallest of the progeny was only 25.5 centimeters. When the shortest of the parents was 30.5 centimeters, that of the progeny was only 15.5 centimeters. In other words the tallest parents were about one-third taller than the tallest progeny, and the shortest progeny were only about one-half as tall as the shortest parents. As may

* Thesis presented for graduation from the College of Agriculture. No. 99.

[1] The Phil. Agr. and For. 6:135-154. 1917.

be noted, in every variety the progeny were very much shorter than the parents.

There are several possible explanations for this difference of vigor between parents and progeny. One would be the lateness of planting. It may be recalled that the parents were planted in May, while the progeny were planted in August. Another reason would be the soil conditions of the seed bed. But the most important explanation is the fact that during the initial growth the progeny seedlings suffered from lack of water because of drought.

## PREPARATION OF PADDIES AND TRANSPLANTING

Six paddies were used in these cultures and designated as 1, 2, 3, 4, 5, and 6. Before planting the present crop, Paddies 1, 2 and 4 were planted to Sinay bean (*Phaseolus calcaratus*), mungo (*Phaseolus mungo*), cowpea (*Vigna sinensis*), respectively. These leguminous crops were plowed under in the preparation of the paddies. Paddies 3 and 5 were newly made paddies. Before turning them into paddies a crop of rice had been previously harvested from Paddy 3, and a crop of corn from Paddy 5. Paddies 1, 2, 3, and 4 adjoined each other. Paddies 5 and 6 were not contiguous to any one of the other four nor to each other. Paddy 5 was about 181 meters west of the first four paddies and Paddy 6 was located 116 meters further west of Paddy 5. Paddy 6 was one of the paddies previously used by Gutierrez. In the preparation of the paddy the method used by the farmers in the vicinity of the College was followed.

As soon as the paddies were ready, transplanting began, and this, together with the subsequent cultural operations, such as replanting, and weeding, were recorded in chronological order, as follows. The distance of planting was 25 cm. × 20 cm.

Sept. 5-6, 1917.—Élites of $5891F_2$ Binicol, $5892F_2$ Binangbang, $5893F_2$ Ganado, $5894F_2$ Iroy, $4896F_2$ Binalayan, and $5896F_2$ Diquet a Bolilising, and multiplication of $5896F_3$ Binalayan were transplanted in Paddy 1.

Sept. 7-8, 1917.—Élites of $5892F_2$ Binangbang, $5893F_2$ Ganado, $5894F_2$ Iroy, $9895F_2$ Binalayan, and $5896F_2$ Diquet a Bolilising and multiplication of $5895F_2$ Binalayan, $5894F_2$ Iroy, $5893F_2$ Ganado and $5892F_2$ Binangbang were transplanted in Paddy 2.

Sept. 8-9, 1917.—Multiplication of $5891F_2$ Binicol, $5892F_2$ Binangbang, $5893F_2$ Ganado, $5894F_2$ Iroy, and $5896F_2$ Diquet a Bolilising were transplanted in Paddy 4.

Sept. 9-10, 1917.—Multiplication of $5891F_2$ Binicol, $5892F_2$ Binangbang, $5893F_2$ Ganado, $5894F_2$ Iroy, $5895F_2$ Binalayan, and $5896F_2$ Diquet a Bolilising were transplanted in Paddy 3.

Sept. 14-15, 1917.—Multiplication of $5892F_2$ Binangbang and $5893F_2$ Ganado were transplanted in Paddy 5.

Sept. 20-22, 1917.—Élites of $5891F_2$ Binicol, $5892F_2$ Binangbang, $5893F_2$ Ganado, $5894F_2$ Iroy, $5895F_2$ Binalayan, and $5896F_2$ Diquet a Bolilising and multiplication of $5892F_2$ Binangbang, $5891F_2$ Binicol, $5895F_2$ Binalayan and $5896F_2$ Diquet a Bolilising were transplanted in Paddy 6.

Sept. 29, 1917.—Replanting of dead plants in Paddy 1 and 4.

Oct. 2, 1917.—Replanting of dead plants in Paddy 6.

Oct. 6, 1917.—Replanting of dead plants in Paddy 3.

Oct. 16, 1917.—Weeding of the paddies.

Three days after transplanting, when the seedlings showed signs of growth, water was allowed to flow in and out of the paddies until the milking stage had passed, when the water was shut off.

Growth observations after transplanting showed that some varieties are greatly affected by transplanting while others are not. $5891F_2$ Binicol, for example, did not show marked growth and tillering until two weeks after transplanting, while $5892F_2$ almost immediately after transplanting exhibited growth and tillering activity. The other varieties recovered very slowly as the growth was gradual. Binicol being an early variety, it is not surprising that two weeks after transplanting its growth became more accelerated than that of the others.

## BLOOMING

Table I shows the number of days it took each variety to head. It may be noted that some varieties, like Ganado, head out very evenly; while others, as in the case of Binicol and Binangbang, require 9 days to complete the heading stage.

TABLE I

| *College Number* | *Variety* | *Number of days required to head* |
|---|---|---|
| $5891F_2$ | Binicol | 7 |
| $5896F_2$ | Diquet a Bolilising | 2 |
| $5895F_2$ | Binalayan | 4 |
| $5894F_2$ | Iroy | 2 |
| $5893F_2$ | Ganado | 1 |
| $5892F_2$ | Binangbang | 9 |

## PESTS AND DISEASES

Several days after transplanting, tip burns were observed. Other troubles, also, appeared. The leaves of some plants were infected with white spots, while those of others turned yellow and many of the plants died. Samples of these white spots and yellowing were taken to Associate Professor Reinking, of the Department of Plant Pathology, for an explanation. He reported that they were not caused by any fungus infection, but most probably were due to physiological troubles brought about by the physical condition of the soil, of the deficient watering of the paddies.

Of the insect pests, the rice bug or *atangia* (*Leptocorisa acuta* Thunb.), and the stem borer (*Schoenobius incertellus* Wlk.) appeared to be very destructive. In the crop of Gutierrez, the stem borer did more damage than *atangia*, but in the present crop the second did more injury than the first. The bugs swarmed the fields and the damage done on the variety Binicol was such that very few grains could be harvested. Some hills had eight or less good grains, but the majority produced no grains at all. The other varieties did not suffer much.

Of the birds, the maya[1] was the most destructive. Plants in Paddies 5 and 6 were badly attacked and no crop could be harvested. These paddies are not included in the results presented in this paper.

## HARVESTING

Table II shows the dates of harvest of the different varieties.

TABLE II

| *College No.* | *Variety Name* | *Dates of Harvest* |
|---|---|---|
| $5892F_2$ | Binambang | Jan. 22-26 |
| $5893F_2$ | Ganado | Jan. 19-26 |
| $5894F_2$ | Iroy | Jan. 16-26 |
| $5895F_2$ | Binalayan | Jan. 12-25 |
| $5896F_2$ | Diquet a Bolilising | Jan. 3-26 |
| $5891F_2$ | Binicol | Dec. 15 |

## GENERAL DISCUSSION OF RESULTS

*The Test Rows:*

As may be recalled, the élites were the parents of the test rows. The chief attributes of these élites were their vigor and high yielding qualities. But the mere fact that these plants were more thrifty and productive than others does not warrant a conclusion that, if their seeds were planted, they would produce equally as thrifty and productive plants. They may or may not, according to the presence or absence of factors which bring about these desirable qualities. Thrift and productiveness may be the result of a favorable

[1] The author evidently refers to the Philippine weaver (*Munia jagori* Martens), a voracious feeder on rice grains.—*Editor.*

location or the presence of an abundant supply of food, in which case these characters are not transmissible to the offspring. On the other hand, if these qualities are brought about by some change in the reproductive cells, they are transmissible. Von Lochow, working with rye, at Petkus, Germany, and Hays with wheat, at the Minnesota Experiment Station,[1] were the ones who first announced the principle that the hereditary value of a plant should not be judged by its own visible marks but by the average value of its progeny. On this principle, which has gained general acceptance among plant breeders is based the head-to-row test.

The yield results of the present experiment, as well as those of Gutierrez which concern the author's findings, are embodied in Table III.

[1] De Vries, Hugo, Plant Breeding: 45. 1907.

TABLE III

| Pedigree Number | $F_2$ Test Rows | | | Multiplication | | Yield of General Stock per Hectare | | | Gain or Loss of Multiplication over General Stock per Hectare | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Yield per Hectare in Cavans of $F_1$ Test Rows | Calculated Yield per Hectare in Cavans | No. of Plants from which Calculated | Calculated Yield per hectare in Cavans | No. of Plants from which Calculated | $F_1$ | $F_2$ | Two year Average | Over $F_2$ or Unselected crop of the same season | Over two-year average of Unselected crop |
| 5892 $F_2$ BINANGBANG | | | | | | | | | | |
| 0809 | 76.2 | 46.27 | 160 | 30.22 | 985 | 41.8 | 24.26 | 33.03 | + 5.96 | — 2.81 |
| 0819 | 73.0 | 56.89 | 227 | 36.12 | 994 | 41.8 | 24.26 | 33.03 | +11.86 | + 3.09 |
| 0820 | 77.2 | 57.66 | 343 | 33.63 | 956 | 41.8 | 24.26 | 33.03 | + 9.37 | + 0.06 |
| 0844 | 93.9 | 70.04 | 225 | 38.14 | 904 | 41.8 | 24.26 | 33.02 | +13.88 | + 5.11 |
| 0845 | 73.5 | 56.51 | 158 | 34.57 | 918 | 41.8 | 24.26 | 33.03 | +10.31 | + 1.54 |
| 0846 | 118.1 | 59.06 | 324 | 29.12 | 876 | 41.8 | 24.26 | 33.03 | + 4.86 | — 3.91 |
| 5893 $F_2$ GANADO | | | | | | | | | | |
| 0405 | 107.4 | 29.39 | 262 | 17.20 | 957 | 50.2 | 14.30 | 32.20 | + 2.90 | —15.00 |
| 0413 | 88.4 | 35.34 | 99 | 15.44 | 852 | 50.2 | 14.30 | 32.20 | + 1.14 | —16.76 |
| 0419 | 90.7 | 42.55 | 95 | 15.44 | 866 | 50.2 | 14.30 | 32.20 | + 1.14 | —16 76 |
| 0478 | 103.7 | | | 21.57 | 1043 | 50.2 | 14.30 | 32.20 | + 7.27 | —10.63 |
| 0487 | 102.8 | 27.90 | 73 | 15.66 | 881 | 50.2 | 14.30 | 32.20 | + 1.36 | —16.54 |
| 0490 | 105.5 | 30.23 | 119 | 17.05 | 1005 | 50.2 | 14.30 | 32.20 | + 2.75 | —15.15 |
| 5894 $F_2$ IROY | | | | | | | | | | |
| 0514 | 132.5 | 20.00 | 56 | 21.39 | 956 | 59.10 | 9.85 | 34.47 | +11.54 | —13.08 |
| 0519 | 136.7 | 31.00 | 177 | 16 02 | 899 | 59.10 | 9.85 | 34.47 | + 6.17 | —13.45 |
| 0526 | 131.1 | | | 13.33 | 862 | 59.10 | 9.85 | 34.47 | + 3.48 | —21.14 |
| 0537 | 113.2 | 28 67 | 142 | 8.21 | 724 | 59.10 | 9 85 | 34.47 | — 1.64 | —26.26 |
| 0545 | 142.3 | 26.14 | 64 | 31.08 | 902 | 59.10 | 9.85 | 34.47 | +21.23 | — 3.45 |
| 0546 | 151.6 | 25.51 | 66 | 22.32 | 840 | 59.10 | 9.85 | 34.47 | +12.47 | —12.15 |
| 5895 $F_2$ BINALAYAN | | | | | | | | | | |
| 0612 | 101.8 | | | 20.46 | 1026 | 51.1 | 15.33 | 33.21 | + 5.13 | —12.75 |
| 0621 | 109.7 | 37.20 | 90 | 23.25 | 796 | 51.1 | 15.33 | 33.21 | + 7.92 | — 9.96 |
| 0617 | 113.0 | 34.83 | 131 | 38.76 | 957 | 51.1 | 15.33 | 33.21 | +23.43 | + 5.55 |
| 0625 | 106.9 | 35.92 | 228 | 28.33 | 976 | 51.1 | 15.33 | 33.21 | +13.00 | — 4.88 |
| 0633 | 124.2 | 51.20 | 201 | 33.63 | 945 | 51.1 | 15.33 | 33.21 | +18.30 | + 0.42 |
| 0636 | 105.1 | 32.39 | 150 | 51.29 | 751 | 51.1 | 15.33 | 33.21 | +35.96 | +18.08 |
| 0641 | 105.6 | | | 23.24 | 861 | 51.1 | 15.33 | 33.21 | + 7.91 | — 9.97 |
| 5896 $F_2$ DIQUÉT | | | | | | | | | | |
| 0705 | 65.1 | 16.29 | 212 | 18.60 | 843 | 34.4 | 15.44 | 24.92 | + 3.16 | — 6.32 |
| 0716 | 62.3 | 22.57 | 103 | 22.32 | 882 | 34.4 | 15.44 | 24.92 | + 6.88 | — 2.60 |
| 0726 | 64.2 | 15.34 | 76 | 30.23 | 487 | 34.4 | 15.44 | 24.92 | +14.79 | + 5.31 |
| 0754 | 93.9 | 24.18 | 205 | 19.99 | 589 | 34.4 | 15.44 | 24.92 | + 4.55 | — 4.93 |

*The Élites:*

Table III shows that the $F_1$ test-rows yielded more than the $F_2$ test-rows and multiplication. This is to be expected, since even if the high-yielding qualities of parents are hereditable, these qualities can not be fully developed in the progeny under all conditions. It depends for its full development upon favorable environmental factors. There is no doubt that the time of planting, the soil quality of the new paddies, and the work of insect and fungus pests influenced the yield of the present crop. This greatly emphasizes the need of having cultures of unselected material as checks. As may be recalled again, $F_2$ seeds were planted in August, while the $F_1$ seeds were planted in May. It may also be recalled that all the paddies used in the present culture were new paddies, which were never planted to rice before. But with all these drawbacks, the yields of the test-rows and the multiplication plots were higher than the yield of the general stock, and it is gratifying to state that even under adverse conditions the selected seeds showed a decided superiority over the general stock, or unselected seed.

## SUMMARY

1. During the initial growth of the seedlings the plants will suffer if water is not abundantly supplied. Since the future stand of the crop and the productiveness of the plants depend in a large measure on how the plants start, it is important that a good stand of the plants be secured during the initial growth. Therefore, the seed-bed should not be allowed to dry up.

2. The $F_1$ test-rows yielded more than the $F_2$ test-rows and the multiplication.

3. Even under adverse conditions the selected seeds show their superiority over the unselected.

4. Until further investigations prove to the contrary, it may be stated that the period from August to December is not the proper season for raising the above varieties, at least in this locality.

## RECOMMENDATION

The work should be continued, and cultures carried on in the paddies used by Gutierrez and the writer, and at two different times of the year—May and August—to find out whether the time of planting really affects the production of these varieties.

# COLLEGE AND ALUMNI NOTES

The Christmas Red Cross Drive at the College of Agriculture netted over one hundred pesos in membership fees and voluntary contributions.

The first meeting of the Agronomy Seminar, which is composed of thesis students and members of the staff of the Department of Agronomy, was held on November twenty-seventh. Acting Dean Baker addressed the meeting on "Keeping Up-to-Date."

Experiments are being conducted by the Class in Agronomy V in connection with the possibility of producing improved types of sugar cane seedlings to replace the present locally grown varieties. Many of the cane fields of the College now being in seed, the Class finds a large amount of material for its work.

The Honorable Mr. Meerkamp van Embden, Consul of the Netherlands, recently paid a visit to the College of Agriculture.

Mr. Primitivo Ramos, Assistant in Chemistry, resigned in order to be able to devote his time to the management of his drug store in Nueva Ecija. Mr. Cecilio Alincastre, of the College of Liberal Arts, has been detailed to this College as Instructor in Chemistry to take the place left vacant by Mr. Ramos.

The Class in Agronomy II spent the first week of Christmas Vacation in a trip to the coconut and abaca growing regions of Laguna and Tayabas provinces.

Mrs. Felipe Delgado, Vice-President of the Philippine Chapter of the American National Red Cross Society, was recently a visitor in the College of Agriculture.

A group of Wilson Hall ladies, accompanied by their matron, Miss Charles, spent a part of their Christmas vacation at the College of Agriculture in conference work. They were temporarily accommodated at the former residence of Dean Copeland.

A number of girls from Assumption College, accompanied by Sisters of that convent and by Dr. Sixto Roxas, were among the recent visitors at the College.

The "Bagobos of Molawin Valley," a local organization composed mostly of College men, entertained members of the faculty of the College of Agriculture at a ball which it gave in the evening of the town fiesta, December sixteenth.

On account of the recent death of Improgo Salcedo, Assistant Professor Inocencio Elayda, of this College, Assistant Secretary of the Fifth Agricultural Congress of the Philippines, becomes its acting secretary.

The Governor of the Department of Mindanao and Sulu requested this College to place every one of the provincial and deputy governors in his Department on the subscription list of the *Agriculturist.* We take this opportunity to thank him for this practical appreciation of the work of the College.

# Weather Observations, October, 1918

OBSERVER—R. ESTIOKO

| | Rainfall in mm. Daily | Rainfall in mm. Weekly | Temperature in °C Max. | Temperature in °C Min. | Temperature in °C Mean Daily | Temperature in °C Mean Weekly | Wind in Miles Daily | Wind in Miles Weekly | Cloudiness | Atmometer Reading in c. c. Evaporation Daily | Atmometer Reading in c. c. Evaporation Weekly | Atmometer Reading in c. c. Insolation Daily | Atmometer Reading in c. c. Insolation Weekly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sept. | | | | | | | | | | | | | |
| 29 | T | | 26.0 | 23.1 | 24.5 | | 34.1 | | ½ cloudy | 17.7 | | 11.0 | |
| 30 | 15.8 | | 28.8 | 23.5 | 26.1 | | 31.1 | | ¾ cloudy | 14.6 | | 1.8 | |
| Oct. | | | | | | | | | | | | | |
| 1 | 0 | | 28.8 | 25.6 | 27.2 | | 111.2 | | clear | 28.8 | | 7.3 | |
| 2 | 0 | | 30.4 | 26.1 | 28.2 | | 159.9 | | ¼ cloudy | 42.5 | | 11.1 | |
| 3 | .5 | | 30.5 | 26.1 | 28.3 | | 125.4 | | clear | 34.0 | | 14.9 | |
| 4 | 4.2 | | 27.5 | 24.6 | 26.0 | | 36.9 | | ½ cloudy | 11.8 | | 5.1 | |
| 5 | .4 | 20.9 | 28.0 | 24.1 | 26.0 | 26.6 | 38.7 | 537.3 | clear | 16.8 | 166.2 | 9.9 | 61.1 |
| 6 | 0 | | 29.0 | 23.1 | 26.0 | | 20.7 | | clear | 14.8 | | 12.4 | |
| 7 | 0 | | 28.2 | 23.1 | 25.6 | | 41.8 | | ¾ cloudy | 12.7 | | 9.2 | |
| 8 | 4.9 | | 28.5 | 23.7 | 26.1 | | 31.5 | | ½ cloudy | 10.8 | | 6.6 | |
| 9 | .7 | | 28.5 | 23.1 | 25.8 | | 17.4 | | clear | 13.0 | | 19.4 | |
| 10 | .8 | | 25.8 | 23.1 | 24.4 | | 27.4 | | ¾ cloudy | 8.5 | | 4.0 | |
| 11 | T | | 28.4 | 22.8 | 25.6 | | 24.3 | | ¾ " | 15.4 | | 7.4 | |
| 12 | 2.0 | 8.4 | 27.8 | 22.6 | 25.2 | 25.5 | 37.3 | 200.4 | ½ " | 16.9 | 92.1 | 5.8 | 64.8 |
| 13 | 10.1 | | 27.0 | 22.4 | 24.7 | | 20.3 | | ½ " | 17.4 | | 5.6 | |
| 14 | .5 | | 28.5 | 22.4 | 25.4 | | 40.4 | | ¼ " | 17.4 | | 6.7 | |
| 15 | 24.2 | | 24.8 | 23.4 | 24.1 | | 64.1 | | cloudy | 7.8 | | 0 | |
| 16 | 35.8 | | 25.8 | 21.6 | 23.7 | | 119.3 | | " | 12.0 | | 4.3 | |
| 17 | 8.9 | | 27.8 | 21.8 | 24.8 | | 81.7 | | ¾ cloudy | 14.1 | | 1.2 | |
| 18 | 13.0 | | 28.5 | 24.8 | 26.6 | | 60.7 | | ¾ " | 12.2 | | 1.8 | |
| 19 | 12.7 | 205.2 | 28.8 | 24.6 | 26.7 | 25.1 | 35.9 | 422.4 | ½ " | 8.3 | 89.2 | 2.5 | 22.1 |
| 20 | 4.3 | | 28.5 | 23.1 | 25.8 | | 21.4 | | ¼ " | 13.8 | | | |
| 21 | 10.9 | | 29.0 | 25.6 | 27.3 | | 38.9 | | ½ " | 18.6 | | | |
| 22 | 1.0 | | 27.2 | 24.8 | 26.0 | | 124.3 | | cloudy | 17.7 | | | |
| 23 | 1.8 | | 30.0 | 23.4 | 26.7 | | 89.6 | | ¾ cloudy | 22.1 | | | |
| 24 | T | | 29.2 | 22.6 | 25.9 | | 34.2 | | clear | 16.7 | | | |
| 25 | T | | 27.5 | 23.1 | 25.3 | | 36.3 | | ½ cloudy | 13.6 | | | |
| 26 | 13.2 | 31.2 | 28.8 | 22.4 | 25.6 | 26.1 | 24.9 | 369.6 | ¾ " | 12.6 | 115.1 | | |
| 27 | T | | 28.8 | 23.4 | 26.2 | | 74.6 | | clear | 18.6 | | | |
| 28 | 4.0 | | 28.5 | 23.6 | 26.0 | | 68.1 | | ¾ cloudy | 13.9 | | | |
| 29 | 0 | | 28.8 | 23.6 | 26.2 | | 67.3 | | ½ cloudy | 18.1 | | | |
| 30 | 3.2 | | 28.5 | 23.4 | 25.9 | | 37.7 | | cloudy | 10.1 | | | |
| 31 | .9 | | 29.0 | 23.8 | 26.4 | | 79.5 | | cloudy | 16.0 | | | |
| Month | | 258.0 | | | | 25.9 | | 1791.7 | | | 507.0 | | |

COLLEGE COFFEE PLANTATION

| | | | | |
|---|---|---|---|---|
| Sept. 29 to Oct. 5 | 14.7 | 30.8 | 21.1 | 25.9 |
| Oct. 6–12 | 12.0 | 29.2 | 20.5 | 24.8 |
| Oct. 13–19 | 218.8 | 27.5 | 18.4 | 22.9 |
| Oct. 20–26 | 52.5 | 28.5 | 20.0 | 24.2 |
| 7 to Nov. 2 | 48.5 | 29.5 | 21.6 | 25.5 |

450 M. ELEVATION MT. MAQUILING.

| Date | Rainfall Weekly |
|---|---|
| Sept. 29–Oct. 6 | |
| Oct. 7–12 | 19.3 |
| Oct. 13–19 | 237.6 |
| Oct. 20–26 | 53.9 |
| Oct. 27 Nov. 2 | 43.7 |

SUMMIT OF MT. MAQUILING

| | | | | |
|---|---|---|---|---|
| Sept. 29 to Oct. 6 | 14.0 | 21.6 | 19.3 | 20.4 |
| Oct. 7–12 | 8.2 | 20.8 | 18.4 | 19.6 |
| Oct. 13–19 | 186.8 | 20.1 | 17.2 | 18.6 |
| Oct. 20–26 | 32.5 | 22.4 | 20.2 | 21.3 |
| 27 to Nov. 2 | 52.6 | 20.1 | 18.8 | 19.5 |

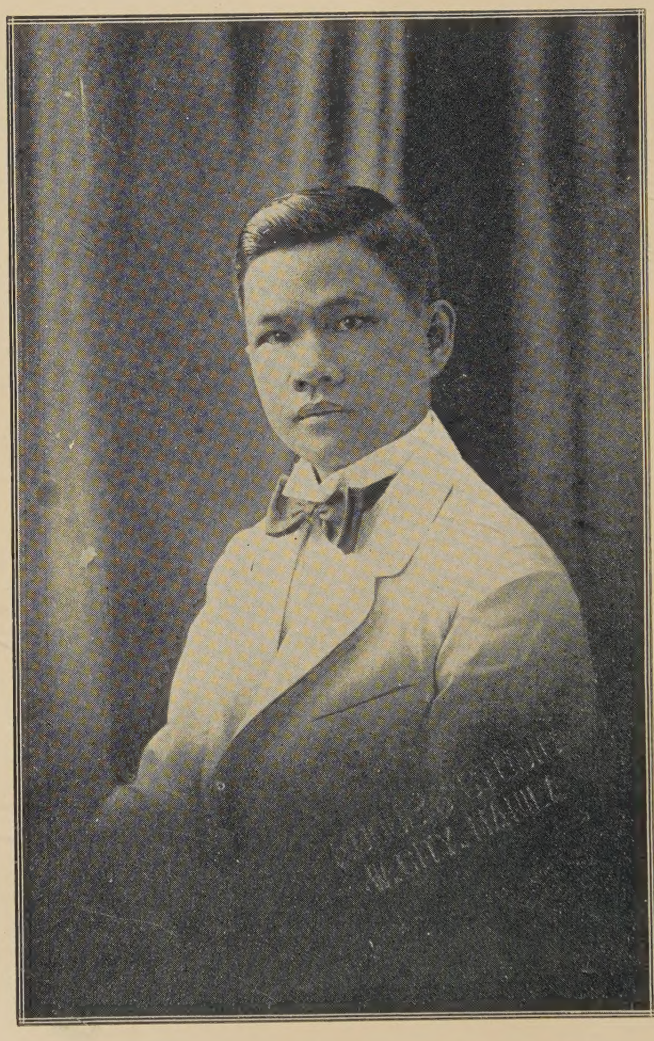
October was notably more windy than the previous months, and therefore had higher evaporation without any greater amount of sunlight. Rainfall was moderate, but evenly distributed.

FORMAN T. MCLEAN,
*Associate Professor of Plant Physiology.*

## TO OUR READERS

On account of circumstances beyond our control, the present issue of the AGRICULTURIST is being published late. Due to the same cause, the January number will not be due to appear on the usual date of issue.

We hope that our subscribers will cooperate with us by exercising their forbearance, as they have many times kindly done on previous occasions. We are taking steps to remedy this situation as to subsequent issues.



HONORABLE GUILLERMO FLAVIER PABLO

**Representative for Zambales and author of Act Numbered 2730 of the Philippine Legislature, providing for the establishment of an Experiment Station at the College of Agriculture**